



# **IMPACT AND PROCESS EVALUATION OF THE 2011 (PY4) AMEREN ILLINOIS COMPANY APPLIANCE RECYCLING PROGRAM**

## **Draft**

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# 1. EXECUTIVE SUMMARY

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The Ameren Illinois Company's (AIC) Appliance Recycling Program (ARP) offers free recycling of refrigerators, freezers, and room air conditioners for residential and some commercial customers. AIC expected this program to garner approximately 4% of electric savings of the overall AIC portfolio (including both residential and commercial sectors) and no therm savings. In line with this level of savings and as described in the evaluation plan, the evaluation team's Program Year 4 (PY4) evaluation reviewed and analyzed the tracking database, and applied savings estimates based on PY3 evaluation activities. The team also interviewed program managers from AIC, Conservation Services Group (CSG), and Appliance Recycling Centers of America (ARCA), the program implementer, for a process review.

## Impact Results

### Gross Impacts

- All participants listed in the program-tracking database were verified for PY4.
- PY4 participation increased by 52% from PY3, increasing from 9,333 appliances (excluding air conditioners) to 14,232.
- Part-use (percentage of time the product is plugged in) for PY4 increased for refrigerators, from 0.88 to 0.91, but decreased for freezers, from 0.93 to 0.85 over PY3. The change in part-use for refrigerators was not statistically significant but the change for freezers was significant at 90% confidence.

### Net Impacts

- In PY4, net-to-gross (NTG) substantially declined, from 0.79 to 0.64 for refrigerators and from 0.82 to 0.65 for freezers. The decline is consistent with prior analysis that predicted a decline in NTG but an increase in program savings associated with opening the program to primary units.
- The NTG change also reflects the participant survey response data. In PY4, a higher proportion of survey respondents indicated they would have disposed of their units by taking them to the scrap yard, dumping them on their own, or having a family member do so for them (32% in PY4 and 24% in PY2). In addition, there were respondents who indicated they would have sold or had their units picked up by a used appliance dealer, but their units were deemed unviable on the secondary market due to age or condition. These responses indicate free ridership, since the unit would have been removed from the grid in the program's absence.

Table 1. Summary of Participant Verification Results

Measure	Units	Participants	Verified Participants	Verification Rate
Refrigerator Recycling	Number of Refrigerators	10,696	10,696	100%
Freezer Recycling	Number of Freezers	3,536	3,536	100%
Air Conditioner Recycling	Number of Air Conditioners	10	10	100%

Table 2. PY4 ARP Program Impacts

Program	PY4 Ex Ante <sup>b</sup> Net Impacts		PY4 Ex Post <sup>a</sup> Net Impacts		Net Realization Rate
	MW	MWh	MW	MWh	
Refrigerator Recycling	1.47	12,397	1.07	9,077	73%
Freezer Recycling	0.46	3,858	0.31	2,586	67%
Air Conditioner Recycling	0.00	9.68	0.00	9.70	100%
<b>Total</b>	<b>1.93</b>	<b>16,264</b>	<b>1.38</b>	<b>11,673</b>	<b>72%</b>

<sup>a</sup> Ex post determined by adjusting part use factors, NTGR, and verified participation.

<sup>b</sup> Ex ante determined by multiplying deemed estimates by participation and PY2 NTGR values.

## Process Results

- For PY4, the incentive increased from \$35 to \$50, which helped drive increased participation.
- Participation in PY4 was also increased by a more aggressive marketing strategy, including the following:
  - The Energy Hog mascot, which included live appearances at community events such as the Illinois State Fair;
  - Initiating a retailer partnership with Sears;
  - Doubling the nonprofit referral bonus (whereby a nonprofit, whom the participant names as a referral entity, is provided cash by), from \$10 to \$20, during the winter holiday season; and
  - Widely distributing printed materials, including advertisements on gas station pumps, coloring pages, and flyers at grocery stores. Additionally, this program collaborated with AIC's lighting program implementer, Applied Proactive Technologies, Inc.(APT) and APT field representatives left brochures at small appliance retailers they would visit as part of the lighting program.
- Contrary to expectations, the increase in nonprofit referral bonus did not bring about an increase in participation during slow winter months.

## Recommendations

- Marketing efforts appear to be very successful in bringing new participants to the program. We recommend AIC continue to deploy current marketing strategies with the exception of the retail partnership.
- While the nonprofit referral portion of the marketing program may be successfully reaching customers, the doubling of the bonus during the winter holidays did not appear to increase participation relative to the same months in PY3. Including an indicator of a nonprofit referral

in the tracking database would allow more accurate assessment of the impact.

- The retail partnership did not appear to significantly contribute to program participation in PY4 (less than 0.5% of participants were marked as having come through the retail channel). In addition, units that are replaced also decrease savings by impacting the part-use factor due to units that had been primary units changing to secondary units after the primary unit is replaced. Details on the application of prospective part-use are provided in section 4.1.4. AIC should carefully consider the relative benefits of continuing the retail partnership.

## 2. INTRODUCTION

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### Program Description

AIC's ARP offers free recycling of refrigerators and freezers to residential and small commercial customers. Participants receive a \$50 incentive payment, and the program implementer picks up and hauls appliances to its recycling facility in Springfield, Illinois. The program not only removes older, inefficient appliances from use in AIC's service territory, but also disposes of them in an environmentally responsible manner.<sup>1</sup>

CSG serves as the primary implementer for all of AIC's residential demand-side management (DSM) programs, and ARCA serves as the subcontractor with primary responsibility for implementing the ARP.

AIC electric customers qualify for the program if they are served under Residential Delivery Service (Rate DS-1) or Small General Delivery Service (Rate DS-2). Equipment must meet the following requirements to qualify for the program:

- Appliances located on account premises and operational at the time of pickup;
- Full-sized units, between 10 and 27 cubic feet; and
- Household-type models (commercial refrigerators and freezers do not qualify).

As an additional service, the program picks up and recycles working room air conditioners when picking up refrigerators or freezers, although air conditioners do not qualify for incentives.

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<sup>1</sup> This includes disposal of oils, PCBs, mercury, and CFC-11 foam, and recycling of CFC-12, HFC-134a, plastic, glass, steel, and aluminum.



## 3. EVALUATION METHODS

### 3.1 DATA SOURCES AND ANALYTICAL METHODS

Table 3 summarizes evaluation methods used to evaluate the PY4 program.

Table 3. Summary of Evaluation Methods

Task	PY4 Impact	PY4 Process	Forward Looking	Details
Program Staff In-Depth Interviews		√	√	Provided insight into design and delivery as well as potential refinements or improvements to the current program. Stakeholders included the AIC and CSG managers, and two ARCA staff.
Participant Survey	√	√	√	Used to verify participation, calculate an NTG ratio, and assess program implementation.
Database Review	√	√		Ensured collection of appropriate data to inform the evaluation.
Gross Savings Calculation	√			Gross impacts are fixed, per-unit values in the Order for Docket 10-0568, adjusted for part-use, as calculated from participant survey results.
Net-to-Gross Calculation	√		√	Updating net savings adjustments, based on survey results applied retrospectively to PY4.

#### 3.1.1 PROCESS ANALYSIS

Participant surveys sought to assess participant satisfaction with the program, sources of program awareness, and wait times for appliance pick-ups. To understand how the program evolved during PY4, the evaluation team interviewed two ARCA staff, AIC's ARP manager, and CSG's ARP manager. Interview topics included the following:

- How has program design changed since its launch?
- What types of impacts did these changes have?
- What marketing approaches have been used, and what results did they produce?

#### 3.1.2 IMPACT ANALYSIS

##### Gross Impacts

Evaluated gross savings were based on unit savings results from the PY3 evaluation impact analysis

and verified participation. We verified participation by comparing the number and type of units in the database to survey respondents and verifying pick-up dates within the PY4 program year.

## Part-Use

PY3 per-unit savings were adjusted to reflect the PY4 part-use factor, calculated using participant survey responses.<sup>2</sup> Details of part-use calculations are provided below in section 4.1.4. For the small number of air conditioners recycled through the program, we applied fixed savings estimates determined as part of the PY2 evaluation.

Overall part-use factors for both refrigerators and freezers are shown in Table 11 and are applied to the *ex ante* gross savings values.

**Table 4. PY4 Overall Part-use Factors by Appliance Type**

Measure	Part Use Factor	Relative Precision
Freezers	0.85	9%
Refrigerators	0.91	6%

Table 12 below shows total program gross savings for PY4. The gross realization rate is a reflection of the updated part-use factor.

**Table 5 PY4 ARP Total Program Gross Impacts by Appliance Type**

Measure	Verified Participant – Units <sup>a</sup>	Ex Ante Gross Savings (MWh) <sup>c</sup>	Ex Post Gross Savings (MWh) <sup>b</sup>	Gross Realization Rate
Refrigerator Recycling	10,696	15,690	14,203	91%
Freezer Recycling	3,536	4,706	3,983	85%
Air Conditioner Recycling	10	9.7	9.7	100%
<b>Totals</b>	<b>14,242</b>	<b>20,406</b>	<b>18,196</b>	<b>89%</b>

<sup>a</sup> Participant verification was 100%

<sup>b</sup> Ex post gross impacts are based on the application of deemed fixed savings values to verified participation numbers, adjusted by part-use.

<sup>c</sup> Ex ante gross impacts were calculated by multiplying deemed fixed savings values by participation numbers.

## Net Impacts

The team developed and applied a NTGR retrospectively to PY4. Per the NTGR framework, this approach was used given a significant change in program design (i.e., the including primary unit).<sup>3</sup> The NTGR was calculated using the following equation.

<sup>2</sup> Part-use factor accounts for appliances that are unplugged for a portion of the year, and is calculated using participant responses on the portion of the year the appliance was in use.

<sup>3</sup> Both the PY4 and Three Year Evaluation Plans specify the retrospective application of the PY4 NTGR. However, we noted one instance in the PY4 plan where the language was not updated to reflect this fact.

$$\text{Net Savings} = \text{Gross per unit savings} * (1 - \text{free rider \%} + \text{spillover \%})$$

### **Free Ridership**

PY4 free ridership was calculated based on responses to participant survey questions regarding what would have happened to the appliance had the program not been available. Overall part-use factors for both refrigerators and freezers are shown in Table 12 and are applied to the ex ante gross savings values.

Table 12. PY4 Overall Part-use Factors by Appliance Type

Measure	Part Use Factor	Relative Precision
Freezers	0.85	9%
Refrigerators	0.91	6%

The part-use factor was then applied to the deemed savings values resulting in gross per-unit savings as shown below

Table **13.**

Table 13. Y4 Gross Per-Unit Savings

Measure	Ex Ante Per-Unit Savings	Part Use Factor	Gross Per-Unit Savings
Refrigerator	1,467	0.91	1,328
Freezer	1,331	0.84	1,127
Room Air Conditioner	968	1	968

Table 14 below shows total program gross savings for PY4.

Table 14. PY4 ARP Total Program Gross Impacts by Appliance Type

Measure	Verified Participant – Units <sup>a</sup>	Ex Ante Gross Savings (MWh) <sup>c</sup>	Ex Post Gross Savings (MWh) <sup>b</sup>	Gross Realization Rate
Refrigerator Recycling	10,696	15,691	14,205	91%
Freezer Recycling	3,536	4,706	3,983	85%
Air Conditioner Recycling	10	9.7	9.7	100%
<b>Totals</b>	<b>14,242</b>	<b>20,407</b>	<b>18,198</b>	<b>89%</b>

<sup>a</sup> Participant verification was 100%

<sup>b</sup> Ex post gross impacts are based on the application of deemed fixed savings values to verified participation numbers, adjusted by part-use.

<sup>c</sup> Ex ante gross impacts are based on multiplying deemed fix savings values by program participation.

Net Impacts, provides full details of NTG calculations and scenarios for determining free ridership. As room air conditioners are picked up only as an additional service to customers already recycling another appliance, and no additional rebate is offered, an NTGR of 1.0 is applied.

## Participant Spillover

Participant survey spillover questions quantified instances where participants' ARP experiences influenced them to participate in other AIC programs or take other actions to improve energy efficiency, outside of AIC programs. Specifically, when customers indicated the program was "very influential" and they did not receive an incentive for the action, the evaluation team included the action in our spillover analysis.

## 3.2 SAMPLING AND SURVEY COMPLETES

### 3.2.1 TELEPHONE SURVEYS

The evaluation team drew a random sample of participants from the program-tracking database, with the sample size designed to achieve 90% confidence and 10% absolute precision for both

refrigerators and freezers. Table 6 presents the targeted sample sizes and achieved completes.

**Table 6. Survey Sample Size and Completes**

Measure	Population	Sample <sup>a</sup>	Quota	Completed Surveys <sup>b</sup>
Refrigerator Recycling	10,696	424	70	71
Freezer Recycling	3,536	392	70	70
<b>Total</b>	<b>14,232</b>	<b>816</b>	<b>147</b>	<b>141</b>

<sup>a</sup> The total sample presented here does not match Table 7 below given that 59 participants in the sample recycled both a refrigerator and a freezer.

<sup>b</sup> Refrigerator participant surveys exceeded the targeted sample by one, due to the final two surveys being completed simultaneously.

## Survey Dispositions and Response Rate

The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).<sup>4</sup> For various reasons, we were unable to determine the eligibility of all sample units through the survey process and chose to use AAPOR Response Rate 3 (RR3). RR3 includes an estimate of eligibility for these unknown sample units. The formulas used to calculate RR3 are presented below. The definitions of the letters used in the formulas are displayed in the Survey Disposition tables below.

$$E = (I + R + NC) / (I + R + NC + e)$$

$$RR3 = I / ((I + R + NC) + (E*U))$$

We also calculated a cooperation rate, which is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who completed an interview out of all of the participants with whom we actually spoke. We used AAPOR Cooperation Rate 1 (COOP1), which is calculated as:

$$COOP1 = I / (I + R)$$

We fielded the survey with ARP participants from August 7–August 16, 2012. Table 7 shows the final survey dispositions.

<sup>4</sup> *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2011. [http://www.aapor.org/AM/Template.cfm?Section=Standard\\_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156](http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions2&Template=/CM/ContentDisplay.cfm&ContentID=3156)

Table 7. ARP Survey Dispositions

Disposition	N
Completed Interviews (I)	141
Eligible Non-Interviews	244
<i>Refusals (R)</i>	137
<i>Mid-Interview terminate (R)</i>	29
<i>Respondent never available (NC)</i>	78
Not Eligible (e)	100
<i>Duplicate Number</i>	1
<i>Non-Working</i>	45
<i>Wrong Number</i>	4
<i>Business/Government</i>	10
<i>Cell Phone</i>	6
<i>No Eligible Respondent</i>	20
<i>Quota Filled</i>	14
Unknown Eligibility Non-Interview (U)	272
<i>Not attempted or worked</i>	41
<i>No Answer</i>	153
<i>Answering Machine</i>	75
<i>Busy</i>	3
<b>Total Participants in Sample</b>	<b>757</b>

The following table provides the response and cooperation rates.

Table 8. ARP Survey Response and Cooperation Rates

AAPOR Rate	Percentage
Response Rate (RR3)	24%
Cooperation Rate	46%

## **4. RESULTS AND FINDINGS**

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### **4.1 PROCESS FINDINGS**

All stakeholders interviewed said the program experienced a successful year in PY4. Overall, the marketing strategy appears to have been very successful. In contrast, program staff reported that the Sears retail partnership, with only 70 appliances recycled, was not as successful as anticipated.

The program experienced higher participation than in previous years, probably because of several factors:

- The incentive amount increased from \$35 to \$50;
- AIC marketed the program more aggressively ; and
- PY4 was the first full year the program opened to primary units.

Participants expressed a high degree of satisfaction with the program, and participation increased by 52% over PY3, from 9,333 appliances to 14,242.

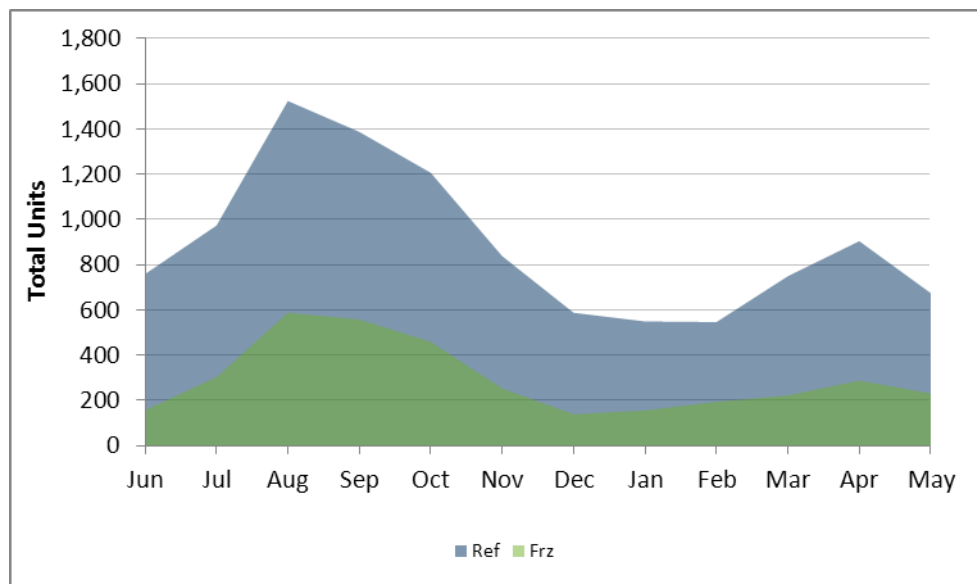
#### **4.1.1 MARKETING AND OUTREACH**

CSG designed and managed the PY4 marketing strategy, which ARCA largely implemented. The most substantial change in the marketing strategy was the introduction of the Energy Hog mascot. The Energy Hog appeared both in printed materials and as a live mascot at public events, including the Illinois State Fair.

The program also continued to reward nonprofit organizations for referring customers to the program. When a customer signs up for the program via the referral, the customer receives the usual incentive and indicates the nonprofit that made the referral. The nonprofit then receives a \$10 bonus for referring the customer. During the winter months in PY4, AIC doubled the referral bonus for nonprofits to increase participation in months with typically lower participation. The change also was designed to build on the holiday season's feelings of generosity. However, participation in November and December declined from PY3 to PY4. In PY3, November participation remained high, at 11% of total annual participation; December participation declined slightly to 8% of annual participation. In PY4, November and December accounted for 8% and 5% of annual participation, respectively, so the increased referral bonus did not have the desired effect of increasing participation during these months. Figure 1 shows participation by month in PY4. The seasonal participation shown here is similar to other ARP programs we have reviewed.



Figure 1. PY4 Program Participation by Month

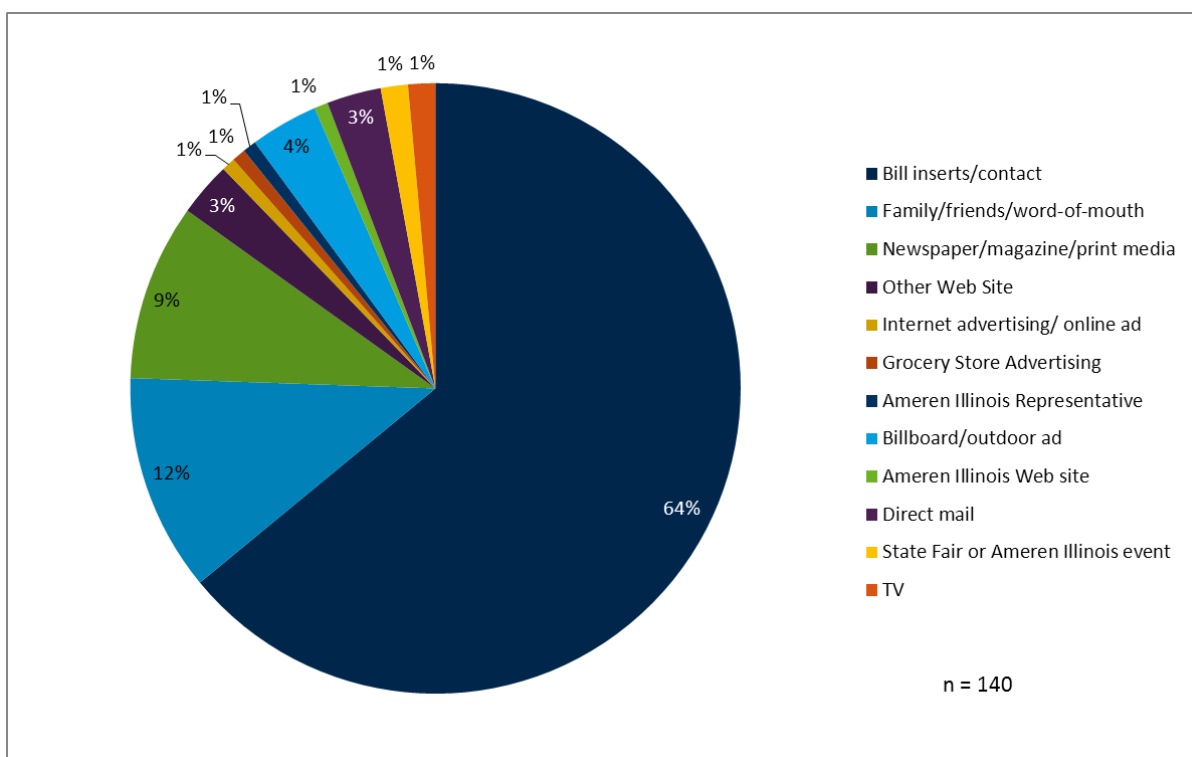


ARCA also initiated a retailer partnership with Sears stores in AIC's service territory. Sears stores' appliance departments provided information about the program at computer kiosks, where customers could sign up directly. Their old appliance would then be picked up for recycling by Sears when their new appliance was delivered. The program leveraged AIC's upstream lighting implementer, APT, which already spent time in the field with smaller "mom-and-pop" retailers, by having them leave ARP brochures and point-of-sale program materials at appliance stores.

CSG and the AIC program manager indicated they expected a greater impact on participation from the Sears partnership.<sup>5</sup> No participant survey respondents indicated they heard of the program through a retailer. Nine percent (9%) of respondents indicated they learned about the program through printed media, which included the retail location brochures. Figure 2 shows how participants learned of the program.

<sup>5</sup> Seventy units came into the program through the Sears partnership.

Figure 2. PY4 Sources of Program Awareness

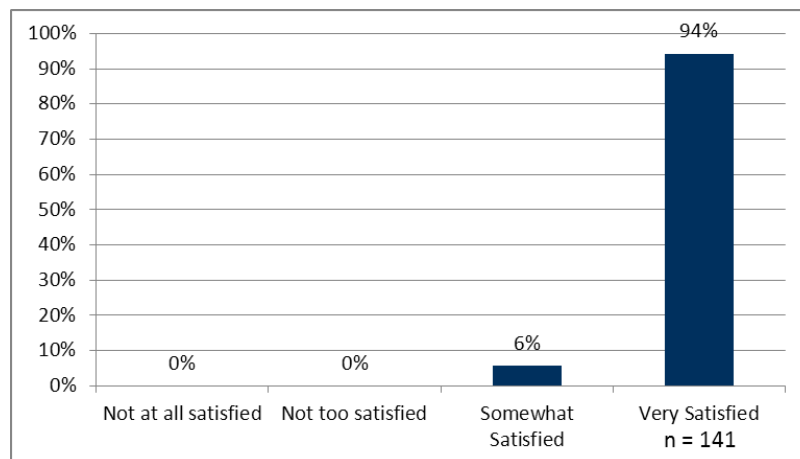


Bill inserts remained the most common source of awareness (64%). AIC sent out several rounds of bill inserts in PY4. Family, friends, and word-of-mouth served as the second most common sources (12%), with one participant specifically mentioning they learned about the program through their church. Newspapers and print media came in third (9%). A small number of respondents specifically indicated they learned about the program from a marketing channel new to PY4, such as the Illinois State Fair and grocery store advertising (one respondent each).

#### 4.1.2 PROGRAM SATISFACTION

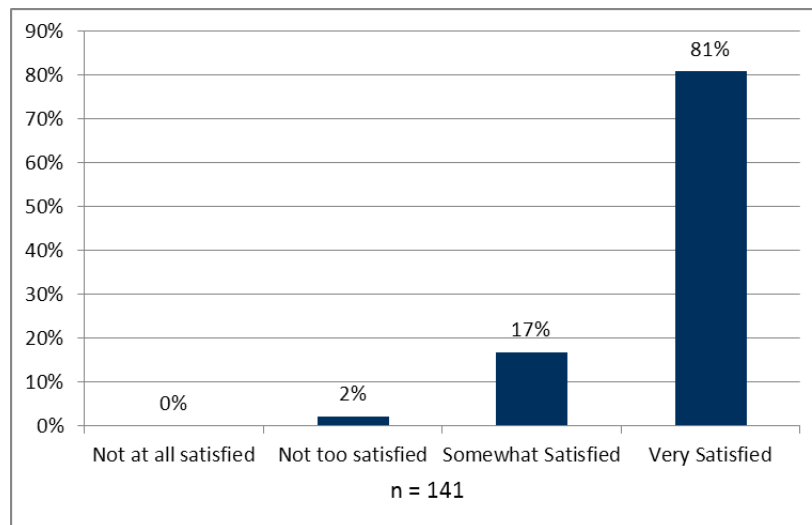
Overall, PY4 program satisfaction was high; 100% of survey respondents indicated they were somewhat or very satisfied, as shown in Figure 3. This high satisfaction level is consistent with similar programs at other utilities across the country.

Figure 3. PY4 Program Overall Satisfaction



Regarding the increased incentive amount, 98% of respondents reported being somewhat or very satisfied. Two percent of respondents said they were not entirely satisfied with their incentive amounts.

Figure 4. PY4 Satisfaction with Incentive Amount



Respondents largely found wait times for appliance pick-ups to be reasonable (95%) while 5% said they thought the wait too long. Even those 5%, however, were satisfied with the program overall. Wait times averaged 15 days; 0.8% waited more than 50 days. Figure 5 shows wait time frequencies calculated as the days between signing up for the program and the pick-up date from the tracking database.

Figure 5. Days from Schedule to Pick-up

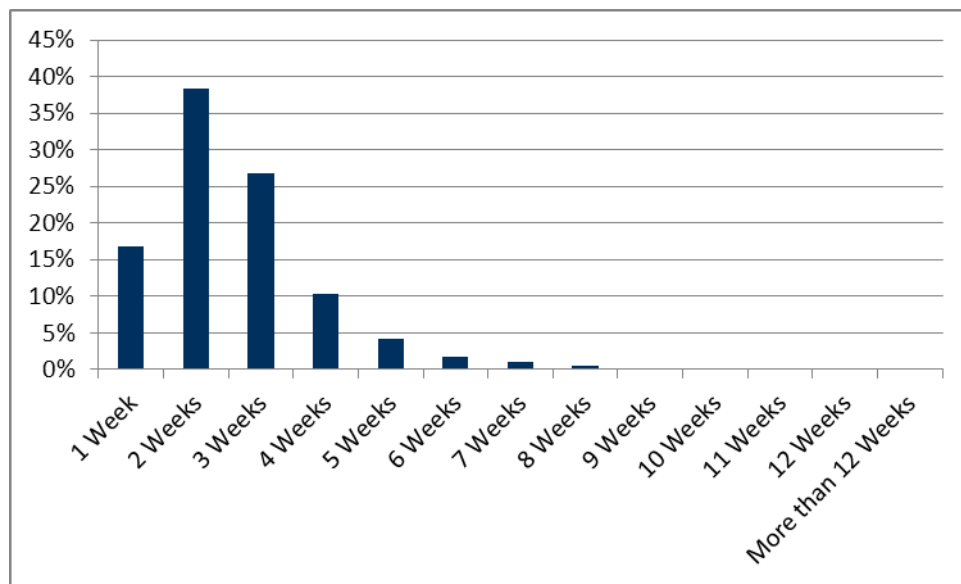
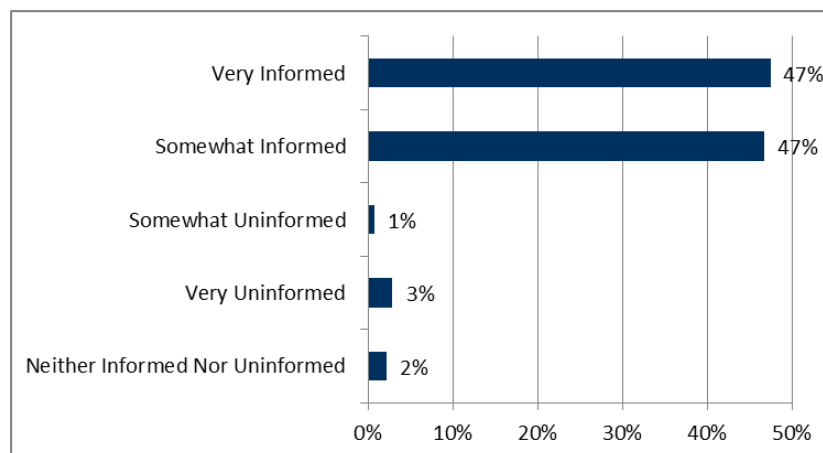


Figure 6 shows that the majority of respondents (94%) consider themselves to be somewhat or very informed about energy efficiency in general.

Figure 6. PY4 Information Level about Energy Efficiency



Survey results suggest that the incentive may not have been the primary motivator for PY4 participants; 70% of participants say they would have participated if the rebate check was lower or not offered at all. Because the increased incentive appears to have contributed to an increase in participation, this topic could have been influenced by “social desirability bias.”<sup>67</sup>

All respondents but one said they would recommend the program to friends and family members.

<sup>6</sup> Jan-Benedict E.M. Steenkamp, Martijn G. de Jong, Hans Baumgartner (2010). Socially Desirable Response Tendencies in Survey Research. *Journal of Marketing Research*: Vol. 47, No. 2, pp. 199-214.

<sup>7</sup> Note that we try to mitigate social desirability bias in our freeridership questions; this is described in section 4.1.5.

## Program Influence

Some ARP participants also participated in other AIC programs. Sixteen percent of respondents indicated they participated in other AIC programs, though only 10% did so after participating in the ARP. Of those 10%, 69% said their experience with the ARP influenced their decision to participate in additional programs. As shown in Table 5, the majority of additional program participation was in the Residential Efficient Products Program.

Table 9. Other AIC Program Participation

REEP Measure	Number of Participants
ENERGY STAR Room Air Conditioner	2
Efficient Water Heaters	1
Programmable Thermostat	1
Smart Power Strips	1
*The remaining four respondents gave open-ended responses that were not clearly attributable to existing programs.	

## Recommendations

- AIC's PY4 marketing efforts were successful in bringing new participants to the program. AIC should continue with current marketing strategies with the following exception:
- The retail partnership did not appear to significantly contribute to program participation in PY4 (less than 0.5% of participants were marked as having come through the retail channel). In addition, units that are replaced also decrease savings by impacting the part-use factor due to units that had been primary units changing to secondary units after the primary unit is replaced. Details on the application of prospective part-use are provided in section 4.1.4. AIC should carefully consider the relative benefits of continuing the retail partnership.

## IMPACT RESULTS

### 4.1.3 PARTICIPANT VERIFICATION

CSG and ARCA maintain a program database that keeps track of numerous data points for each recycled unit, including the following:

- Customer name and address;
- Unit type (refrigerator/freezer);
- Pickup description (first or second unit picked up from household);
- Incentive amounts;
- Unit characteristics, including age, size, defrost type, and configuration; and
- AIC's estimated energy and demand savings.

The evaluation team reviewed the database to verify the number and types of units to calculate overall savings. The evaluation team also verified the number of units recycled through the

participant survey and found that 100% of the records were accurate.

#### 4.1.4 GROSS IMPACTS

In the PY3 evaluation, the evaluation team independently estimated energy and demand savings for recycled refrigerators and freezers using a regression analysis, data provided in the program-tracking database, and data collected in customer surveys. To estimate gross program savings for PY4, the evaluation team relied on per-unit values from the PY3 evaluation report<sup>8</sup>.

The part-use factor accounts for participating appliances not plugged in year-round, prior to participation. The Cadmus Group calculated part-use factors for refrigerators and freezers using PY4 participant survey data. Based on responses provided, we categorized each participant as one of the three part-use categories listed in Table 10. Possible part-use values ranged from 0 (not plugged in at all) to 1.0 (plugged in year round). The rationale for assigning a part-use factor of zero to those indicating the appliance was not in use at all during the preceding year was that no savings would be generated by the appliance's retirement (since it did not previously consume any energy).

**Table 10. Part-Use Factors by Participant Category**

Participant Part-Use Category	Part-Use Factor
Not running at all during the previous year	0
Running part time during the year*	0 to 1
Running throughout the year	1
<i>*Participants who used their appliance during part of the year are given a part-use factor that is a ratio of the total months they were using the appliance divided by the total months in the year (12).</i>	

Since participating appliances may have been used differently had they not been recycled through the program (e.g., what was previously a primary refrigerator might have become a secondary refrigerator), we applied the determined historical part-use rates for secondary units to primary units, that is to consider how the appliance would have been used had it not been recycled through the program. In determining the appropriate part-use factor, we considered how the unit was likely to be used in the future, without the program. An existing secondary unit would likely continue its current usage pattern, while a primary unit that absent the program would have become a secondary unit, might be different. Therefore, for primary appliances that would have become secondary in the program's absence, we apply the average part-use factor for existing secondary units (since historical usage patterns would not be accurate and would over-estimate savings).

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<sup>8</sup> For the PY3 analysis, Cadmus used measure-specific regression models, based on the California Energy Commission's energy consumption database, with over 61,000 specific refrigerator and freezer makes and models, manufactured between 1978 and 2008. The database contained unit energy consumption (UEC) values for each appliance (as reported by manufacturers using Department of Energy appliance testing protocols). The regression model employed the UEC as the dependent variable, and various characteristics (configuration, age, size, etc.) of refrigerators or freezers as independent variables.

Since it is unknown whether a discarded appliance would have been used in a primary or secondary capacity in its new location, the evaluation team applies the overall historical average (which reflects a mix of primary and secondary usage). Primary refrigerators have a part-use factor of one.

Table 11 shows part-use factors for secondary refrigerators, primary refrigerators, and the part-use for all refrigerators. The overall part-use for refrigerators is the weighted average of the three historical usage patterns.<sup>9</sup>

**Table 11. PY4 Part-use Factors for Secondary and All Refrigerators**

Measure	Part Use Factor	Relative Precision
Secondary Refrigerator	0.87	9%
All Refrigerators	0.90	7%
Primary refrigerators	1	NA
<b>Overall Weighted Average Refrigerators</b>	<b>0.91</b>	<b>6%</b>

Overall part-use factors for both refrigerators and freezers are shown in Table 12 and are applied to the *ex ante* gross savings values.

**Table 12. PY4 Overall Part-use Factors by Appliance Type**

Measure	Part Use Factor	Relative Precision
Freezers	0.85	9%
Refrigerators	0.91	6%

The part-use factor was then applied to the deemed savings values resulting in gross per-unit savings as shown below

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<sup>9</sup> In cases where a previously primary refrigerator would have become a secondary refrigerator without the ARP, Cadmus applied the part-use factor for secondary units. This exception was made for appliances (1) staying within the participating home; and (2) used in a room other than the kitchen in the program's absence; and (3) if survey respondents indicated they replaced the unit. This exception prevents over-stating savings associated with refrigerators that would have been used as secondary units without the program.

Table **13**.



Table 13. Y4 Gross Per-Unit Savings

Measure	Ex Ante Per-Unit Savings	Part Use Factor	Gross Per-Unit Savings
Refrigerator	1,467	0.91	1,328
Freezer	1,331	0.84	1,127
Room Air Conditioner	968	1	968

Table 14 below shows total program gross savings for PY4.

Table 14. PY4 ARP Total Program Gross Impacts by Appliance Type

Measure	Verified Participant – Units <sup>a</sup>	Ex Ante Gross Savings (MWh) <sup>c</sup>	Ex Post Gross Savings (MWh) <sup>b</sup>	Gross Realization Rate
Refrigerator Recycling	10,696	15,691	14,205	91%
Freezer Recycling	3,536	4,706	3,983	85%
Air Conditioner Recycling	10	9.7	9.7	100%
<b>Totals</b>	<b>14,242</b>	<b>20,407</b>	<b>18,198</b>	<b>89%</b>

<sup>a</sup> Participant verification was 100%

<sup>b</sup> Ex post gross impacts are based on the application of deemed fixed savings values to verified participation numbers, adjusted by part-use.

<sup>c</sup> Ex ante gross impacts are based on multiplying deemed fix savings values by program participation.

## 4.1.5 NET IMPACTS

Net savings are the result of free ridership and spillover adjustments based on participant survey responses:

1. Free riders – If a participant would have disposed of their unit in a manner that would have taken the unit off the grid in absence of the program, the utility cannot claim savings for those units.
2. Spillover – When participants install other energy savings measures that are not incented by the utility and the participant's decision to install the measure was highly influenced by their experience in the ARP, those savings can be claimed by the utility.

The resulting net savings are equal to:

$$\text{Net Savings} = \text{Gross per unit savings} * (1 - \text{free rider \%} + \text{spillover \%})$$

In future years, we will also adjust Net Savings for “induced replacement” which is defined as when the recycling program combination of incentives and removal of the existing unit actually induced the participant to purchase a replacement product, they were not already planning to replace. In this

case savings are equal to the annual consumption of the recycled appliance less than annual consumption of the new unit. This year the participant survey included questions for determining induced replacement. All relevant methodology, calculations, and results are provided in section **Error! Reference source not found..** However, as mentioned above, the results were not applied to the PY4 NTGR but are supplied for information only. In future evaluation years induced replacement will be included in net savings adjustments.

Detailed methodology for determining these impacts are outlined below.

### **Free Ridership**

To calculate the program's NTG, the evaluation team based its analysis on the self-report approach methodology, established in the 2004–2005 California Residential Appliance Recycling Program evaluation, and continued in more recent evaluations, both in California and elsewhere in the United States.<sup>10</sup>

The NTG adjustment negates energy savings from participants whose appliances would have been removed from service independently of the program (free riders), but credits the program for destroying units that would have continued to be used within participating homes, or that would have been transferred to other users for continued use.

If the participating appliance had not been recycled through the ARP, it would have followed one of four other scenarios:

1. The unit would have been kept by the household, but not used.
2. The unit would have been kept by the household, and still be used.
3. The unit would have been discarded by the household through a method resulting in the unit's destruction.

Scenarios 1 and 3 indicate free ridership. Under these scenarios, free ridership occurs because the units would have been removed from the grid even though not recycled through the program. As a result, the program could not claim energy savings generated by recycling these appliances. To determine the percentage of participants in each of the four scenarios, each surveyed participant was asked the likely fate of the participating appliance, had it not been recycled through the ARP. Cadmus' analysis of these survey response data yielded the results in Table 15.

**Table 15. PY4 Free Ridership by Appliance**

Appliance	Free Ridership %	Precision
Refrigerator	37%	10%
Freezer	36%	10%

To ensure the highest quality of responses possible and to mitigate a socially desirable response bias, the evaluation team used an iterative approach in the survey free ridership battery bringing to attention several pertinent facts. These facts—such as the cost of disposing a refrigerator at a local waste station, whether local charities accept used refrigerators, and the findings of market research

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<sup>10</sup> [http://www.calmac.org/publications/EM&V\\_Study\\_for\\_2004-2005\\_Statewide\\_RARP\\_-\\_Final\\_Report.pdf](http://www.calmac.org/publications/EM&V_Study_for_2004-2005_Statewide_RARP_-_Final_Report.pdf)

regarding resale viability—offer important context when participants are asked their hypothetical action in the absence of the program.

PY4 experienced a markedly higher percentage of free riders than did PY2, the last year in which AIC measured free ridership. This result is similar to what other programs have experienced when they began to pick up primary units,<sup>11</sup> and is in line with the evaluation team’s prior analysis, which predicted a decline in free ridership that would be offset by the increase in savings from increased participation.

PY4 survey results indicated 34% of recycled appliances were primary units. Cadmus tested whether there was a difference in the number of free riders between primary and secondary units as determined by the participant survey. We found no statistically significant difference between the two, although the sample sizes were too small to be conclusive. Table 16 below shows the tests for differences.

**Table 16. PY4 Free Ridership Comparison among Different Respondents**

Respondent Type	Free Ridership		Difference <sup>a</sup>
	Primary	Secondary	
Refrigerators Only Recycled	63%	63%	-1%
Refrigerators and Freezers Recycled	59%	65%	-5%

<sup>a</sup> None of the differences are statistically significant, though samples sizes were too small to be conclusive.

## Spillover

Participants may be influenced to install other energy-efficiency measures outside of AIC’s programs. The evaluation team asked participants to list additional, energy-efficient items they installed on their own, e.g., not through an AIC program. We also asked them to rate the program’s influence on their installation decision. If a customer said the program was extremely influential in their installation decision, we counted that measure as spillover. For each type of measure, the evaluation team estimated energy savings, either in comparison to federal standard efficiency using the ENERGY STAR calculator, or using savings estimates from other AIC programs.<sup>12</sup>

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<sup>11</sup> “Primary Refrigerators: An Examination of Appliance Recycling Program Design” completed by The Cadmus Group for Ameren Illinois, 2011

<sup>12</sup> The team calculated the spillover rate for refrigerators and freezers together.

Table 17. Spillover Measure Savings

Spillover Measure	High Influence Quantity	Elec Savings (kWh) per unit	Total kWh	Percent of Spillover
CFL	24	38	912	60.6%
ES Freezer	1	141	141	9.4%
ES Dishwasher	4	35	140	9.3%
ES Room AC	3	104	312	20.7%
<b>Total</b>	<b>32</b>	<b>N/A</b>	<b>1,505</b>	<b>100.0%</b>

The team calculated spillover rate as the ratio of the additional measure savings that were highly influenced by the program, and the total gross savings for the survey participants.

Table 18. Spillover - kWh

Program Category	Spillover Savings for Survey Respondents (kWh)	Ex Post Gross Program Savings for Survey Respondents (kWh)	Spillover Rate (%)
Appliance Recycling	1,505	173,146	0.9%

The team also found spillover measures that generated gas savings. Two percent of respondents reported additional measures installed that were highly influenced by the program and generated 315 therms of gas savings (one water-heater and two high-efficiency furnaces). As shown in Table 19, gas spillover measures accounted for an additional 29,293 program therms savings.<sup>13</sup>

Table 19. Spillover - Therms

Number of Sample Measures Highly Influenced	Total Savings	Average Therm Savings per Respondent (n=141)	Total Participant Population <sup>a</sup>	Therms Savings
3	315	2.23	13,112	29,293

<sup>a</sup> Total participants is not equal to the number of verified units, but rather the number of unique customers.

## Replacement

Because the PY4 program recycled primary appliances, many survey respondents indicated they replaced units they recycled (65%). Because in most cases a \$50 incentive and the removal of the existing unit is not likely to motivate participants to purchase an otherwise unplanned replacement unit (which could cost as much as \$1,500), not all units replacements could be attributed to the program. However, if a customer would have not purchased the replacement unit (putting another appliance on the grid) in absence of the program, the net program savings reflect this fact. This is, in

<sup>13</sup> For the purpose of this analysis, we currently assume that participants are combination customers. However, we will explore this further between the draft and final report.

effect, akin to negative spillover. Therefore, the team assessed *program-influenced* replacement to inform the evaluation.

The initial basis for determining program-induced replacement derived from responses to the survey question: “Just to confirm: you are saying that you would NOT have replaced your old appliance without the incentive you received from Ameren Illinois for recycling it, is that correct?”

Though this question seems straightforward, contradictory answers to other survey questions mean that this question alone may not be sufficient to determine induced replacement.

“Correct” responses to the above question would be considered invalid if the respondent also claimed they would have discarded their primary/main refrigerators independently of the program, based on the logic that all primary/main refrigerators would be replaced. If the customer would have discarded the appliance without the program, the program could not have induced replacement. Only if the respondent indicated they would have kept a primary appliance would induced replacement be possible. Figure 7 illustrates the logic outlined above.

Figure 7. Induced Replacement Logic

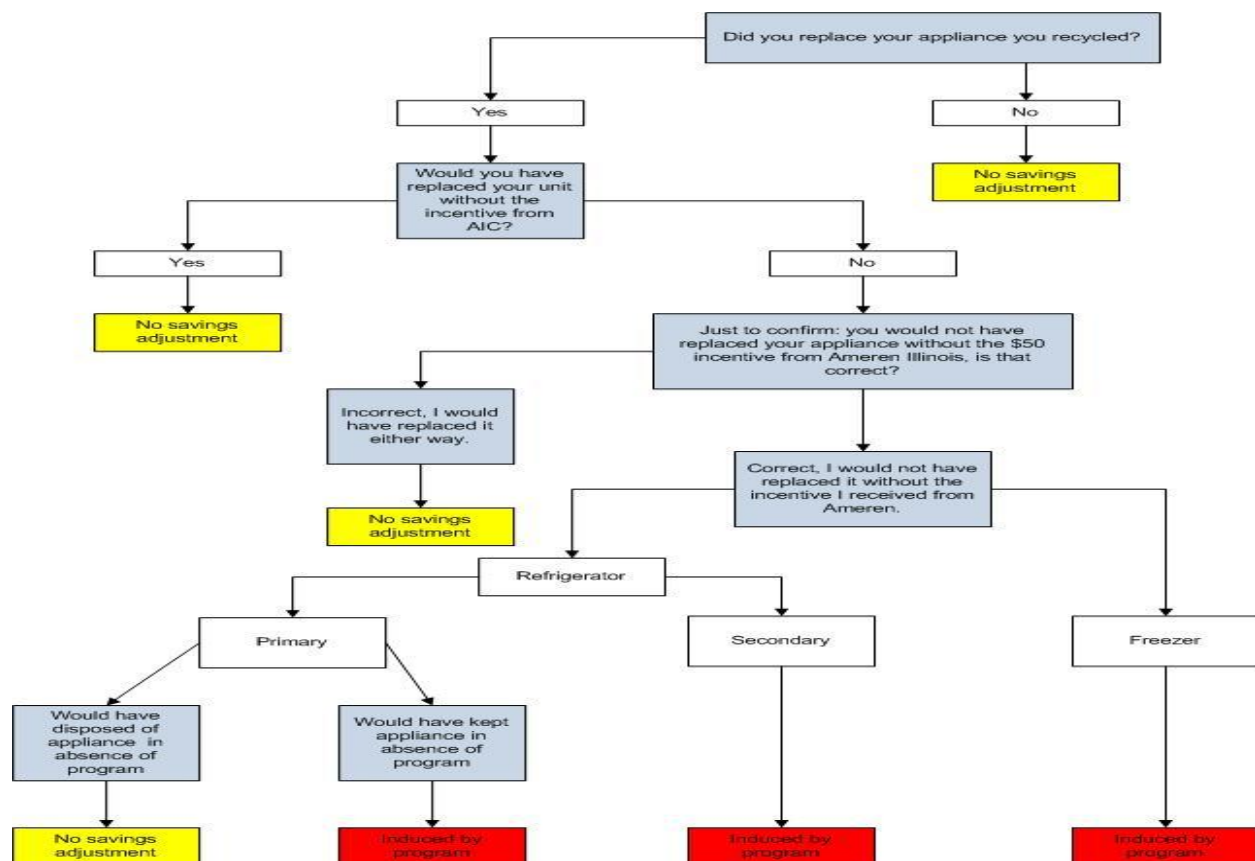


Table 20 shows Cadmus’ calculation of the replacement savings adjustment. Cadmus assumed an average new refrigerator or freezer consumes 500 kWh annually, and multiplied this figure by the percentage of survey respondents reporting program-induced replacement to arrive at the average kWh replacement adjustment.

Table 20. Induced Replacement kWh Adjustment

Appliance	New Unit Consumption (kWh)	Participants Reporting Program-Induced Replacement (%)	Average Replacement Adjustment (kWh)
Refrigerators	476	1%	14
Freezers	342	2%	23

### Final Net Savings

Final net savings included adjustments for spillover but not induced replacement. As shown in Table 21. , AIC's PY4 NTGR is similar, though slightly higher, than what has been observed in other programs that allow primary units.

Table 21. Free Ridership Comparison

Utility	NTG - Refrigerators
PG&E 06-08	51%
SCE 06-08	56%
SDG&E 06-08	58%
OPA 08-09	54%
Ameren PY4	64%

The resulting net savings are equal to:

$$\text{Net Savings} = \text{Gross per unit savings} * (1 - \text{free rider \%} + \text{spillover \%})$$

Table 22. Ex Post Per-Unit Savings

Scenario	Ex post Gross Per-Unit Savings (kWh)	Free Ridership	Spillover	Ex post Net Per-Unit Savings (kWh) <sup>a</sup>	NTGR
Refrigerator	1,328	37%	0.9%	849	64%
Freezer	1,127	36%	0.9%	731	65%
Room Air Conditioner	968	0%	0%	968	100%

<sup>a</sup> The values in the table may not be exact due to rounding.

The ex ante NTGR used was 0.79 for refrigerators and 0.82 for freezers based on the PY3 evaluation report.

Table 23. PY4 ARP Total Program Net Savings

Measure	Verified Participant – Units	Ex Ante <sup>b</sup> Net Savings (MWh)	Ex Post <sup>a</sup> Net Savings (MWh)	Net Realization Rate
Refrigerator Recycling	10,696	12,397	9,077	73%
Freezer Recycling	3,536	3,858	2,586	67%
Air Conditioner Recycling	10	9.7	10	100%
<b>Totals</b>	<b>14,242</b>	<b>16,264</b>	<b>11,673</b>	<b>72%</b>

<sup>a</sup> Ex post savings determined by applying verification rates, updated part-use factors, and updated NTGR.

<sup>b</sup> Ex ante net savings were determined by multiplying deemed savings estimates by participation and PY2 NTGRs.

Total PY4 ARP net program savings were 11,673 MWh, a 41% increase in savings over PY3.

## **A. APPENDIX: DATA COLLECTION INSTRUMENTS**

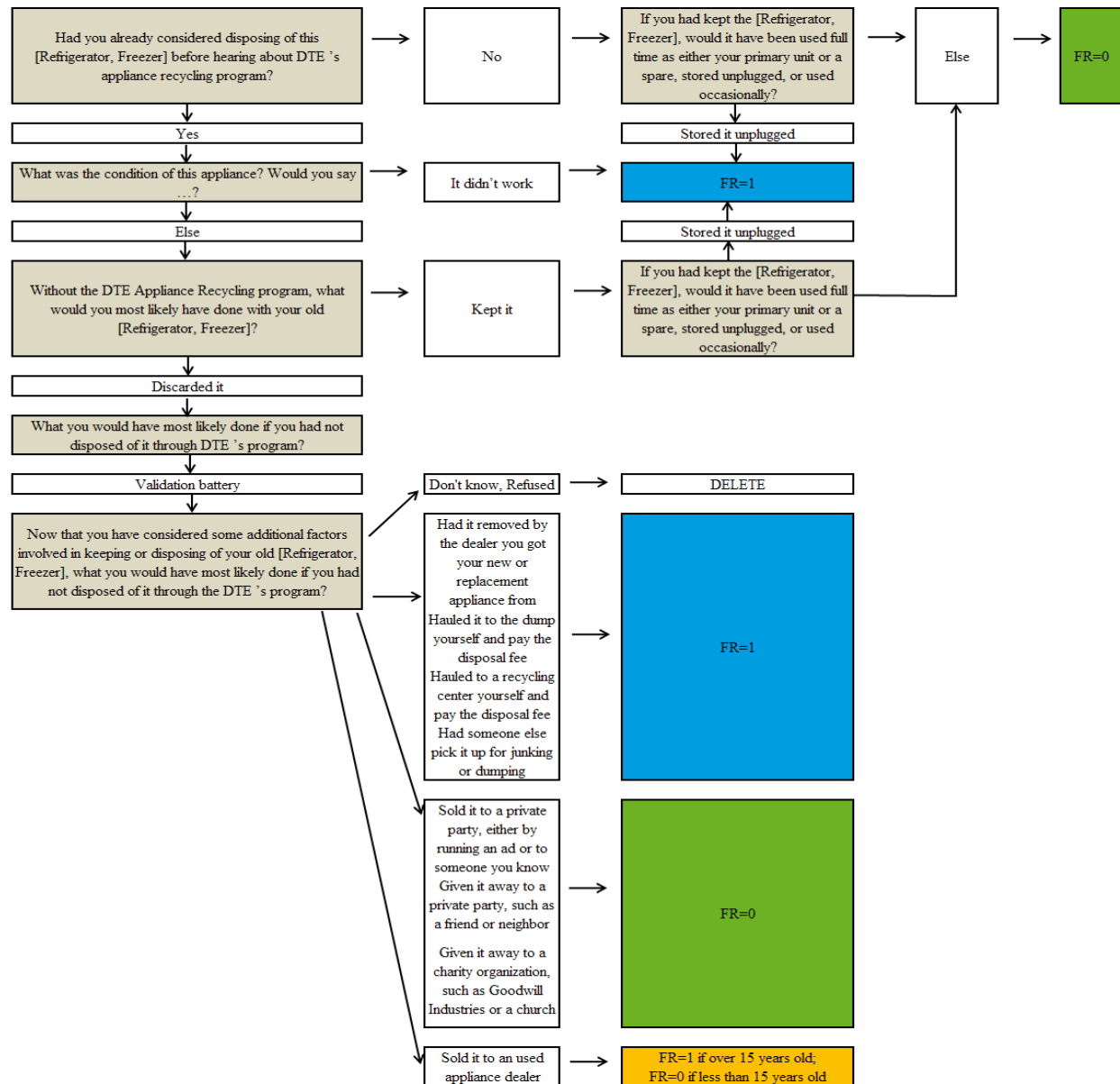
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PY4 ARP Survey  
Final.pdf



## B. APPENDIX: NTG ALGORITHM



From top to bottom on the left:

E9 informs the first brown box in the diagram, E8 the second brown box. E19 informs the third.

F1 through F16 are the validation battery before the final brown box which is informed by F17.

E20 through E22 inform the boxes in the top right of the diagram.

- E8. How would you describe the condition of the <SURVERAPP> you got rid of? Would you say ...?  
**[READ, RECORD ONE RESPONSE ONLY.]**
1. It worked well and was in good physical condition.
  2. It worked okay but had some problems **[Example: it wouldn't defrost].**
  3. It didn't work
  - 98. Don't know
  - 99. Refused
- E9. Had you already considered disposing of the <SURVERAPP> before you heard about Ameren Illinois's Appliance Recycling Program? Disposal includes any means of getting the appliance out of your home including selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center yourself.
1. Yes
  2. No
  - 98. Don't know
  - 99. Refused
- E20. Would you have kept the old <SURVERAPP> in the same location you mentioned earlier? That is would it have been located in the **[READ IN ANSWER FROM QError! eference source not found.]?**
1. Yes **[GO TO QError! Reference source not found.]**
  2. No
  - 98. Don't know **[GO TO QError! Reference source not found.]**
  - 99. Refused **[GO TO QError! Reference source not found.]**
- E21. Where would you have relocated the recycled **[refrigerator/freezer]** to if you had kept it?  
**[PROMPT IF NECESSARY]**
1. Kitchen
  2. Garage
  3. Porch/patio
  4. Basement
  5. Other [Specify] \_\_\_\_\_
  - 98. Don't know
  - 99. Refused
- E22. **[SKIP TO QError! Reference source not found. IF QError! Reference source not found.=1]** If eren Illinois's program had not been available, how soon do you think you would have disposed of your old <SURVERAPP>? Would you have disposed of it within a year of when the Program took it, or more than a year later?
1. Within a year of when the program took it
  2. More than a year later

- 98. Don't know
- 99. Refused

F17. Now that we have talked about various ways you could have gotten rid of your **[refrigerator/freezer]**, what do you really think you would have most likely done with it without the Ameren Illinois's program? **[READ LIST ONLY IF NEEDED]**

1. Sold it to a private party, either by running an ad or to someone you know
2. Sold it to an used appliance dealer
3. Given it away to a private party, such as a friend or neighbor
4. Given it away to a charity organization, such as Goodwill Industries or a church
5. Had it removed by the dealer you got your new or replacement appliance from
6. Hauled it to the dump yourself and pay the disposal fee
7. Hauled to a recycling center yourself and pay the disposal fee
8. Had someone else pick it up for junking or dumping
9. Kept it
10. Some other way **[RECORD VERBATIM]**

-98. **[DO NOT READ]** DON'T KNOW

-99. **[DO NOT READ]** REFUSED

## C. APPENDIX: IMPLEMENTATION MODEL

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The evaluation team created an implementation model for the Appliance Recycling Program (ARP) that was evaluated in PY4. An implementation model is a graphic presentation of the intervention—what occurs and who undertakes the functional activities of the program.

The model, created in a multi-level Visio format, displays various functions in rows with the key stakeholders and processes in columns. We determined these functions, stakeholders, and processes by reviewing the available program documentation, which we further refined in interviews with program staff. This model does not attempt to assess program effects.

The model is organized by function and the stakeholders involved.

- **Functions** represent the discrete purposes established by the program. These functions include program administration and design, marketing and outreach, and service delivery. Service delivery encompasses activities directed toward intervention recipients and, as shown in this model, is a catch-all for any activity that does not fit in another function.
- **Stakeholders** are the various providers who are involved in program delivery or those who receive program services. Stakeholders include the customer, market actors, AIC, Conservation Services Group (CSG), and Appliance Recycling Centers of America (ARCA). Market actors represent several groups that were involved in marketing efforts in PY4: Sears, lighting field representatives, small “mom and pop” retailers, and nonprofits. Their roles in the program are detailed in the marketing and outreach section below.

We also identified several key points within each of the program functions.

- **Program Administration and Design:** CSG designs the program based on goals set by AIC, which in turn are based on recent potential studies. Forecasts account for historical participation, new opportunities, and estimated unit savings. CSG manages the marketing budget. ARCA is the field implementer that manages the logistics of the program.
- **Marketing and Outreach:** For PY4, CSG developed a multimedia campaign, featuring the Energy Hog. Collateral and other marketing initiatives included:
  - Direct mail, bill inserts, newspaper print ads, online display ads, truck signage; signage in malls, grocery stores and gas stations; posters and flyers at events; and email blasts to customers
  - The Energy Hog mascot, which included live appearances at public events, including the 30,000<sup>th</sup> refrigerator pickup media event.
  - Retailer partnership with Sears (POS materials, door clings) and retail brochures in a variety of stores with point-of-sale materials (distributed by APT)
  - Referral program that rewards nonprofit organizations for referring customers.

CSG manages all marketing and creative design and ARCA implements the direct mail and community advertising (grocery stores; gas stations; malls) and the Sears partnership.

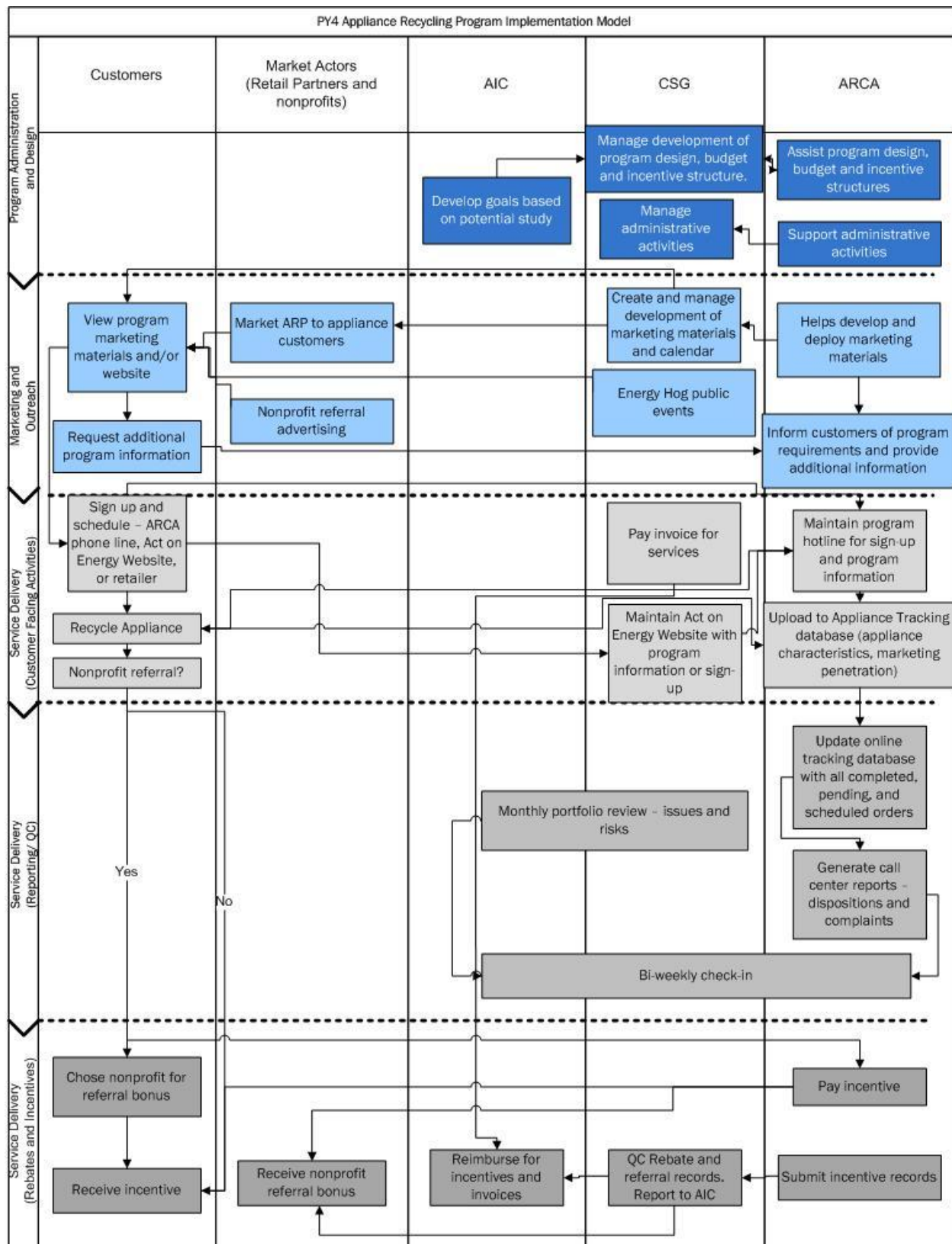
- **Service Delivery (Customer Facing Activities):** CSG provides content for the ActOnEnergy website where customers can learn about the program. Customers also can sign up through

the ARCA call center or a website maintained by ARCA and seamlessly linked from ActOnEnergy. Further, ARCA manages most customer service activities, including scheduling, answering questions, and fielding customer complaints. ARCA also picks up units from participants' homes and recycles them in a local Springfield, Illinois recycling facility.

- **Service Delivery (QA/QC and Reporting):** ARCA is responsible for data collection, which includes auditing field data and customer service interaction incident. ARCA provides customer information to CSG to verify questionable accounts. In addition, ARCA manages an online order tracking database that allows AIC and CSG to monitor for performance management.
- **Service Delivery (Rebates and Incentives):** ARCA provides the customer rebate and referral data to CSG for QC and Invoice/Savings processing.
- **Customer Rebate Data:** CSG verifies that the customer data meets program criteria. CSG pays the ARCA invoice and submits to AIC for payment. CSG houses a database of completed incentive payments and savings for monthly reporting to AIC.
- **Referral Data:** CSG verifies referral participants and pays the non-profits. CSG submits to AIC for payment. CSG archives a database of referrals paid for reporting purposes.

The ARP Program implementation model follows. The figure to the right is the key.

## Appendix: Implementation Model



## D. APPENDIX: SURVEY FREQUENCIES

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PY4 ARP Tables.pdf